UNITED STATES PATENT APPLICATION

SYSTEM AND METHOD FOR TESTING A COMMUNICATIONS SERVER

INVENTOR

Andrew Warner

of Edina, Minnesota

Schwegman, Lundberg, Woessner, & Kluth, P.A.

1600 TCF Tower

121 South Eighth Street

Minneapolis, Minnesota 55402

ATTORNEY DOCKET 977.035US1

System and Method for Testing a Communications Server

Field of the Invention

The present invention is related to the testing of communication devices, and more particularly to a system and method for testing communications servers capable of establishing a plurality of simultaneous modem connections..

Background Information

The Internet has created additional demand for communication services. At first, Internet service providers met this demand by installing banks of modems. This approach was inefficient, unreliable and costly. With the advent of telecommunications standards such as V.90, it has been possible to build dense communications servers which consolidate functions in fewer boxes, make more efficient use of pooled devices and allocate ports to different applications dynamically as they are needed.

Remote Access Server (RAS) concentrators have been developed by companies like Digi International of Minnetonka, Minnesota to receive incoming connections from, for example, branch offices and telecommuters. These products aggregate or concentrate up to 30 simultaneous analog (K56flex or V.90) or digital (ISDN) connections onto one T1, E1 or ISDN Primary Rate Interface (PRI) line. One of Digi's single PCI slot products, the DataFire RAS 60, can handle as many as 60 simultaneous high-density modem channels or ISDN B channel connections over two T1/E1/PRI lines.

Testing collections of concentrators can be difficult. For instance, a large Internet Service providers may be configured to handle ten thousand simultaneous analog or digital connections. Testing of such systems under load requires that one make ten thousand simultaneous connections. In the past such a test would require a bank of ten thousand analog or digital modems. Such an approach is cumbersome, unreliable and costly.

What is needed is a system and method for testing communication systems which support large numbers of simultaneous connections without the need for individual modems.

Summary of the Invention

According to one aspect of the present invention, a system and method of testing a bank of modems is described. A test bed includes a RAS concentrator, wherein the RAS concentrator includes means for spoofing operation of a plurality of modems. The RAS concentrator is connected to a communication server having one or more concentrators or a bank of modems. Software is executed in the test bed to establish a plurality of simultaneous connections between the RAS concentrator and the bank of modems.

According to another aspect of the present invention, a system for testing a communications server which provides a plurality of simultaneous modem connections includes a communications medium, a processor and a RAS concentrator connected to the processor and the communications medium. The RAS concentrator includes a signal processor for managing a plurality of modem connections and a communications interface connected to the signal processor and the communications medium, wherein the signal processor operates under program control to spoof individual modem connections across the communications medium.

According to yet another aspect of the present invention, a system for testing a communications server which provides a plurality of simultaneous modem connections includes a Public Switched Telephone Network, a processor and a RAS concentrator connected to the processor and the Public Switched Telephone Network. The RAS concentrator includes a signal processor for managing a plurality of modem connections and a Public Switched Telephone Network interface connected to the signal processor and the Public Switched Telephone Network, wherein the signal processor operates under program control to spoof individual modem connections across the Public Switched Telephone Network (PSTN) interface.

According to yet another aspect of the present invention, a RAS concentrator includes a processor and a Public Switched Telephone Network (PSTN) interface connected to the processor. The processor operates under program control to spoof individual modem connections across the Public Switched Telephone Network (PSTN) interface.

According to yet another aspect of the present invention, a RAS concentrator adapter includes a processor, a computer interface and a Public Switched Telephone Network (PSTN) interface connected to the processor. The processor operates under program control to spoof individual modem connections across the Public Switched Telephone Network (PSTN) interface. The computer interface is capable of communicating with a computer.

Brief Description of the Drawings

Fig. 1 illustrates a system for testing a communications server;

Fig. 2 illustrates another system for testing a communications server;

Fig. 3 illustrates an RAS concentrator adapter according to the present invention;

Fig. 4 illustrates information categories in V.8 which are modified during analog spoof mode;

Figs. 5-7 illustrate identification fields in V.8bis which are modified during analog spoof mode; and

Fig. 8 shows one embodiment of a bitmap register used to control analog spoof mode in one embodiment of the present inventions.

Description of the Preferred Embodiments

In the following detailed description of the preferred embodiments, reference is made to the accompanying drawings which form a part hereof, and in which is shown by way of illustration specific embodiments in which the invention may be practiced. It is to be understood that other embodiments may be utilized and structural changes may be made without departing from the scope of the present invention.

Some portions of the detailed descriptions which follow are presented in terms of algorithms and symbolic representations of operations on data bits within a computer memory. These algorithmic descriptions and representations are the ways used by those skilled in the data processing arts to most effectively convey the substance of their work to others skilled in the art. An algorithm is here, and generally, conceived to be a self-consistent sequence of steps leading to a desired result. The steps are those requiring physical manipulations of physical quantities. Usually, though not necessarily, these quantities take the form of electrical or magnetic signals capable of being stored, transferred, combined, compared, and otherwise manipulated. It has proven convenient at times, principally for reasons of common usage, to refer to these signals as bits, values, elements, symbols, characters, terms, numbers, or the like. It should be borne in mind, however, that all of these and similar terms are to be associated with the appropriate physical quantities and are merely convenient labels applied to these quantities. Unless specifically stated otherwise as apparent from the following discussions, terms such as "processing" or "computing" or "calculating" or "determining" or "displaying" or the like, refer to the action and processes of a computer system, or similar computing device, that manipulates and transforms data represented as physical (e.g., electronic) quantities within the computer system's registers and memories into other data similarly represented as physical quantities within the computer system memories or registers or other such information storage, transmission or display devices.

A system for testing a communications server is shown in Fig. 1. As shown in Fig. 1, a communications server 28 provides a number of simultaneous modem connections 30 (shown as 30.1 through 30.N) to a communications medium such as a Public Switched Telephone Network. In one embodiment, modem connections 30.1 through 30.N are individual modems and communications server 28 is a bank of modems. In another embodiment, modem connections 30.1 through 30.N are provided by one or more RAS concentrators in a manner known in the art.

In one embodiment, communications server 28 includes a processor 32 which communicates over a network 34 to one or more servers 36 (shown as 36.1 through 36.M). In one such embodiment, servers 36 are file servers. Servers 36 could also be Web servers, print servers, etc.

In the embodiment shown in Fig. 1, communications server test system 10 includes a communications medium 12 and a test bed 11. Test bed 11 includes a processor 14 and a RAS concentrator 16. RAS concentrator 16 is connected to processor 14 and to communications medium 12 and includes a signal processor 18 for managing a plurality of modem connections and a communications interface 20. Communications interface 20 is connected to signal processor 18 and to communications medium 12. Signal processor 18 operates under program control to spoof individual modem connections across communications medium 12 in the manner to be described below.

In the embodiment shown in Fig. 1, test system 10 also includes a device 24 connected to test bed 11. Device 24 is capable of receiving and reading articles comprising computer readable media. Examples of articles comprising computer readable media are floppy disks, hard drives, CD-ROM or DVD media or any other read-write or read-only memory device.

In the embodiment shown in Fig. 1, communications medium 12 includes a Public Switched Telephone Network 22.

Another embodiment of a system 10 for testing a communications server is shown in Fig. 2. As in Fig. 1, in the embodiment shown in Fig. 2, communications server test system 10 includes a communications medium 12 and a test bed 11. Test bed 11 includes a processor 14 and a RAS concentrator adapter 16. RAS concentrator adapter 16 is connected to processor 14 and to communications medium 12 and includes a signal processor 18 for managing a plurality of modem connections and a communications interface 20. Communications interface 20 is connected to signal processor 18 and to communications medium 12. Signal processor 18 operates under program control to spoof individual modem connections across communications medium 12 in the manner to be described below. In this embodiment, however, test bed

11 is connected directly to communications server 28 via a connection such as ISDN PRI, T1 or E1.

In the embodiment shown in Fig. 2, test system 10 also includes a device 24 connected to test bed 11. Device 24 is capable of receiving and reading articles comprising computer readable media. Examples of articles comprising computer readable media are floppy disks, hard drives, CD-ROM or DVD media or any other read-write or read-only memory device.

In one embodiment, RAS concentrator 16 is an adapter card which plugs into a computer. Such an embodiment is shown in Fig. 3. In Fig. 3, concentrator 16 includes a computer interface 26 such that concentrator 16 can be plugged into a computer motherboard. In such an embodiment, processor 18 includes program code for operating in analog spoof mode as is discussed below.

In one embodiment, test bed 11 is connected to communications medium 12 via a digital interface. In one such embodiment, a four wire interface is used so that echo cancellation can be disabled.. Such a connection also permits the highest possible connection speeds for more thorough testing.

Each RAS concentrator 16 is digitally connected but must be able to spoof an analog modem. In one embodiment, a V.90 or K56flex modem-based communications server 28 is tested by spoofing communication server 28 during either V.8 or V.8bis connection negotiations.

In one V.8 embodiment, the Call Menu signal (CM) or the Joint Menu signal (JM) is manipulated to reflect a predefined set of options. Signals CM and JM enable Data Circuit-terminating Equipments (DCEs) to choose the best V-Series modulation mode from those available in both the call and answer DCEs. The CM/JM exchange also provides for protocol selection, PSTN access indication, and non-standard facilities.

Signals CM and JM use a common coding format. This coding format, and the whole of the V.8 protocol, is described in ITU-T Recommendation V.8, available from the International Telecommunication Union, which descriptions are incorporated herein by reference. Each signal consists of a repeated sequence of bits, with some of the bits

used for synchronization and others for transmitting information. Some of the information categories defined for V.8 are shown in Fig. 4.

In one embodiment, the information categories used to spoof modem connections across communications medium 12 are modulation mode 40, V.90 availability 42 and PSTN access 44. Modulation mode 40 is set to indicate V.90 availability (b5 = 1). V.90 Availability 42 is configured such that V.90 analogue modem availability is indicated (b5 = 1) but V.90 digital modem availability is not indicated (b6 = 0). PSTN Access 46 is configured to show that test bed 10 is using an analogue network connection indicated (b7 = 0). Once the appropriate CM of JM signal is transmitted, training proceeds in an ordinary fashion.

In one V.8bis embodiment, one or more of the Capabilities List (CL), Mode Select (MS), and Capabilities List Request (CLR) messages is manipulated to reflect the following set of options:

Identification Field {SPar(1)} (see Fig. 5):

Network type indicated as analogue (b1 = 0)

Identification Field {NPar(2)} [see Fig. 6]:

No parameters set (b1 - b6 = 0)

Standard Info Field - Data{NPar(2)} - Octet 3 (see Fig. 7):

V.90 analogue modem indicated (b5 = 1)

V.90 digital modem not indicated (b6 = 0)

The V.8bis protocol is described in ITU-T Recommendation V.8bis, available from the International Telecommunication Union, which description is incorporated herein by reference.

Analogous techniques can be used for other PCM-based asymmetric modulations schemes such as K56Flex.

The above selections would not normally be made by a digitally connected PCM modem. Therefore, each concentrator 16 must include firmware which permits the selection and a mechanism which overrides the defaults for the above values.

In one embodiment, test bed 10 includes a bitmap register 50 that controls several options. Such a register 50 is shown in Fig. 8. In one embodiment, register 50 is an eight bit register having the following bit fields. Fields 52 and 54 are unused and set to zero. Field 56 is used to disable V.8bis and K56flex (a logic "0" enables V.8bis and K56flex while a logic "1" disables V.8bis and K56flex). Field 58 enables the digital V.90 client (a logic "0" disables the digital V.90 client while a logic "1" enables the digital V.90 client). Field 60 determines if the concentrator requests a leased connection from the signaling subsystem ("0" is normal operation, "1" is a request).

In one embodiment, field 60 is set/cleared automatically by AT&LL command but it may be subsequently modified for testing purposes.

Field 62 selects analog spoof mode for digital modems ("0" is normal operation, "1" tells concentrator 16 to enter an analog spoof mode where concentrator 16 lies during V.8/V.8bis about its capabilities and pretends to have an analog connection to communications medium 12. This mode is most useful when combined with field 58 = "1" above.

Field 64 tells concentrator 16 to display call progress and disconnect messages for ISDN calls ("0" is normal operation, "1" tells concentrator 16 to display call progress and disconnect messages for ISDN calls. Field 66 is unused and is set to zero.

In one embodiment, the default value for register 50 is 8 (all fields but field 58 set to zero). In another embodiment, the default value for register 50 is 0 (all fields set to zero).

In one embodiment, data pump modulation and negotiation code can be obtained from Vocal Technologies of _____, _____. In one such embodiment, the code includes hooks that allow register 50 to be mapped by software on the appropriate fields of the V.8 or V.8bis specification as discussed above. Once the modes of operation are established, training continues as described in the V.90 specification.

Conclusion

The test approach discussed above simplifies management of the test. In contrast to analog testing in the past, one can now look at the digital lines. In addition, the approach permits the highest possible connection speeds and eliminates the need for echo cancellation or suppression. Analog spoof mode is used to make the device under test think it is communicating with a number of individual analog modems, permitting the testing of communication servers at the highest speed and under the greatest load. Concentrators are used to simplify the test bed, increasing reliability and lowering cost.

In the above discussion, the term "computer" is defined to include any digital or analog data processing unit. Examples include any personal computer, workstation, set top box, mainframe, server, supercomputer, laptop or personal digital assistant capable of embodying the inventions described herein.

Although specific embodiments have been illustrated and described herein, it will be appreciated by those of ordinary skill in the art that any arrangement which is calculated to achieve the same purpose may be substituted for the specific embodiment shown. This application is intended to cover any adaptations or variations of the present invention. Therefore, it is intended that this invention be limited only by the claims and the equivalents thereof.